

# Radiologic Assessment of Pituitary Microadenomas

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Radiographs of 146 patients who had a pituitary adenoma removed by the transsphenoidal approach were reviewed. The area and volume of the sella were measured in all the patients. In 73 patients the sella had a normal size and appearance as shown on routine lateral and frontal radiographs. However, thin-section tomograms of the sella in these patients demonstrated findings indicative of an intrasellar mass in all but three instances. The diagnosis of pituitary microadenoma (adenoma less than 1.5 cm in diameter) may, therefore, be missed if only plain skull radiographs are used to assess the sella. No correlation could be shown between the location of the sellar changes seen using thin-section tomography and the histologic type of pituitary adenoma.

The detection of pituitary microadenomas (tumors less than 1.5 cm in diameter) represents an increasingly important problem for the endocrinologist, gynecologist, neurosurgeon, and neuroradiologist. In most instances, the tumor is first suspected because of endocrine abnormalities, such as galactorrhea and amenorrhea. The diagnosis of a secreting pituitary adenoma is usually confirmed by hormonal assays and radiographic findings.

We investigated whether sellar area and volume, as measured on plain skull radiographs, could be used as reliable indicators of small pituitary adenomas. We also assessed the importance of thin-section tomography in detecting microadenomas. An attempt was also made to predict the histologic character of a pituitary adenoma on the basis of radiographic changes in the configuration of the sella.

## Materials and Methods

Skull radiographs and thin-section tomograms of 146 consecutive patients who had had a pituitary adenoma removed via the transsphenoidal approach were reviewed. The histologic type of adenoma was determined by means of clinical presentation, laboratory analysis, and by light and electron microscopy. The adenomas were classified as secreting and nonsecreting. Secreting adenomas were subdivided into those that secreted adrenocorticotrophic hormones (ACTH), those secreting human growth hormones (HGH), and those secreting prolactin. Nonsecreting adenomas were often associated with pituitary hypofunction but frequently were asymptomatic and were noted as an incidental finding on skull radiographs.

The area and volume of the sella were determined for every patient from plain frontal and lateral skull radiographs and from anteroposterior and lateral tomograms of the sella obtained at 2 mm intervals using the hypocycloidal motion of the Polytome. Correction for magnification was made in all instances. The area of the sella was calculated by multiplying its length by its height. The volume of the sella was calculated by multiplying

half the length times the height times the width [1]. The length of the sella was determined by taking the greatest sagittal distance from the anterior wall of the sella to the most posterior portion of the posterior wall (fig. 1). The height was measured from the level of the tuberculum sellae to the most inferior portion of the floor of the sella. The width of the sella was the widest portion of the floor of the sella [2]. The upper limits for normal length and height of the sella were considered to be 16 mm and 13 mm, respectively, and the upper limit for normal area was considered to be 208 mm<sup>2</sup> [3]. The upper limit for normal volume of the sella was considered to be 1,500 mm<sup>3</sup> [4, 5].

In patients found to have a sella of normal area and volume, the tomograms were further analyzed for a localized expansion or abnormal configuration. The floor of the sella as seen on anteroposterior tomograms was divided into three equal portions: right lateral, central, and left lateral. The floor of the sella as seen on lateral tomograms was divided into two portions: anterior or anteroinferior and posterior or posteroinferior. If the expansion involved more than one portion, it was classified as general.

## Results

Of the 146 pituitary adenomas studied, 75% were secreting and 25% nonsecreting adenomas (table 1). Nonsecreting adenomas tended to be larger. Of the nonsecreting adenomas, 72% caused a greater than normal sellar area and 64% produced an abnormal sellar



Fig. 1.—Measurement of length, depth, and width of sella (from [1]).

TABLE 1  
Classification of Microadenomas

Microadenoma	No.	%
Secreting:		
ACTH . . . . .	21	14
Prolactin . . . . .	31	21
HGH . . . . .	58	40
Total . . . . .	110	75
Nonsecreting . . . . .	36	25

Note. —ACTH = adrenocorticotrophic hormone, HGH = human growth hormone.

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TABLE 2  
Sellar Area and Volume

Microadenoma	No. Patients	Area		Volume		
		Normal ( $\leq 208 \text{ mm}^2$ )	Abnormal ( $> 208 \text{ mm}^2$ )	Normal [1] ( $< 1,100 \text{ mm}^3$ )	Normal [4, 5] ( $< 1,500 \text{ mm}^3$ )	Abnormal ( $> 1,500 \text{ mm}^3$ )
Secreting:						
ACTH .....	21	20 (95)	1 (5)	18 (86)	20 (95)	1 (5)
Prolactin .....	31	23 (74)	8 (26)	18 (58)	24 (77)	7 (23)
HGH .....	58	16 (28)	42 (72)	13 (22)	16 (28)	42 (72)
Nonsecreting .....	36	10 (28)	26 (72)	9 (25)	13 (36)	23 (64)

Note. — Numbers in parentheses are percentages.



Fig. 2. — Pituitary microadenoma with localized expansion of sella along its anteroinferior margin. A-C, Lateral tomographic sections of sella separated by 4 mm intervals. Localized bulging (arrow) of sella floor is visible.

TABLE 3  
Location of Changes in Sellar Configuration on Lateral Tomograms

Microadenoma	Sellar Location			Normal Configuration
	Anterior	Posterior	General	
Secreting:				
ACTH .....	11	1	5	3
Prolactin .....	10	2	12	0
HGH .....	11	1	4	0
Nonsecreting .....	4	2	7	0

Note. — Data on 73 patients with normal sellar area and volume

volume (greater than  $1,500 \text{ mm}^3$ ) (table 2). The HGH-secreting adenomas (acromegaly) tended to be the largest of the secreting adenomas. Of these patients, 72% had an abnormal sellar area and an abnormal sellar volume. The ACTH-secreting adenomas (Cushing's disease) and the prolactin-secreting tumors tended to be smaller at the time of surgery than the HGH-secreting adenomas. Among the prolactin-secreting tumors only 26% had produced an abnormal sellar area, and 23% had produced an abnormal sellar volume. Only 5% of the ACTH-secreting adenomas caused an abnormal sellar area and volume. Of the 146 patients, 73 (50%) had a sella of normal area and volume. The lateral thin-section tomograms, however, demonstrated abnormal configuration of the sella in all but three.

Changes in the configuration of the sella were most commonly noted on lateral tomograms (table 3). Localized expansion or bulging of the sella was usually seen along the anterior or anteroinferior margins of the sella

(figs. 2-4). These changes were determined by comparing one side of the sella to the other. Changes in configuration were usually seen on two adjacent tomographic sections (i.e., separated by 2 mm). Septa in the sphenoid sinus can sometimes change the configuration of the anterior wall or floor of the sella and should not be confused with changes caused by a pituitary adenoma.

Frontal tomograms of the sella frequently showed no abnormality even when the lateral tomograms were abnormal (table 4). The floor of the sella on anteroposterior projections is normally flat or slightly convex inferiorly. The lateral corners of the floor normally appear rounded and smooth. Microadenomas may depress the floor on one side (fig. 4). As the adenoma enlarges, it may depress the floor further and cause the lateral corner to change to a more acute angle.

A normal configuration of the sella was noted on frontal tomograms of 33 of the 73 patients exhibiting normal sellar area and volume. Of these 33 patients, 30 showed expansion in the anterior and anteroinferior portions of the sella on lateral tomograms. Frontal tomograms were, therefore, considered to be less sensitive in demonstrating changes in these locations. Localized expansion of the sellar floor in the anterior or anteroinferior portion were more readily detected on lateral tomograms.

### Discussion

Sellar area and volume measurements are insensitive indicators of the presence of a pituitary microadenoma. In this series, 95% of the ACTH-secreting adenomas and approximately 75% of the prolactin-secreting adenomas

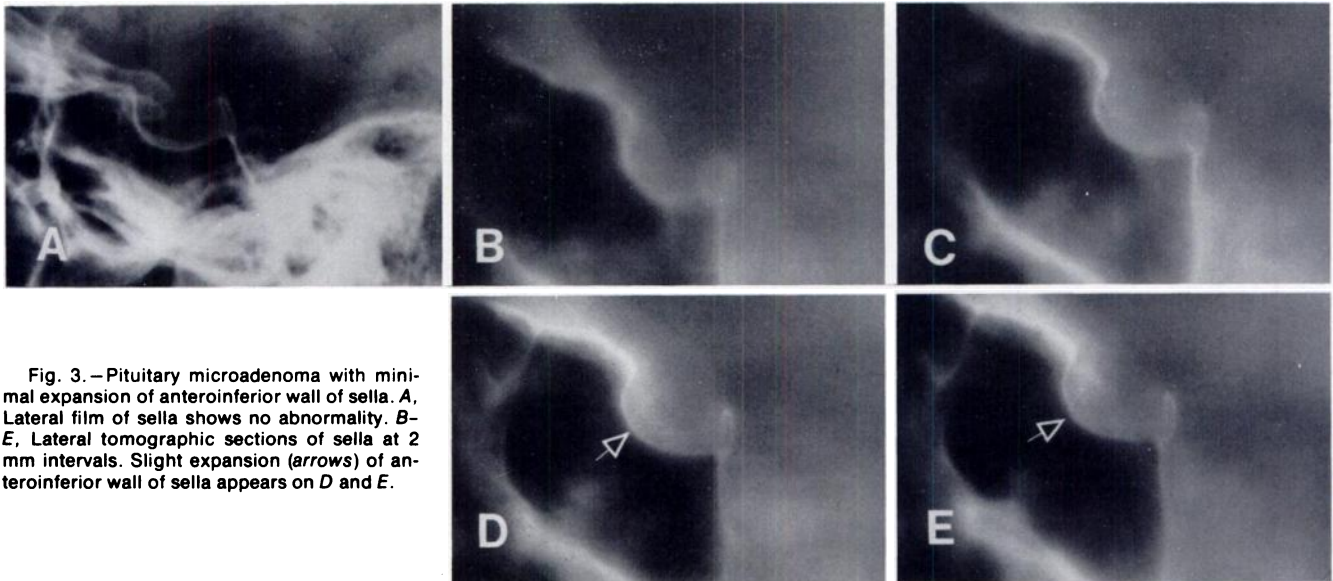


Fig. 3.—Pituitary microadenoma with minimal expansion of anteroinferior wall of sella. A, Lateral film of sella shows no abnormality. B–E, Lateral tomographic sections of sella at 2 mm intervals. Slight expansion (arrows) of anteroinferior wall of sella appears on D and E.

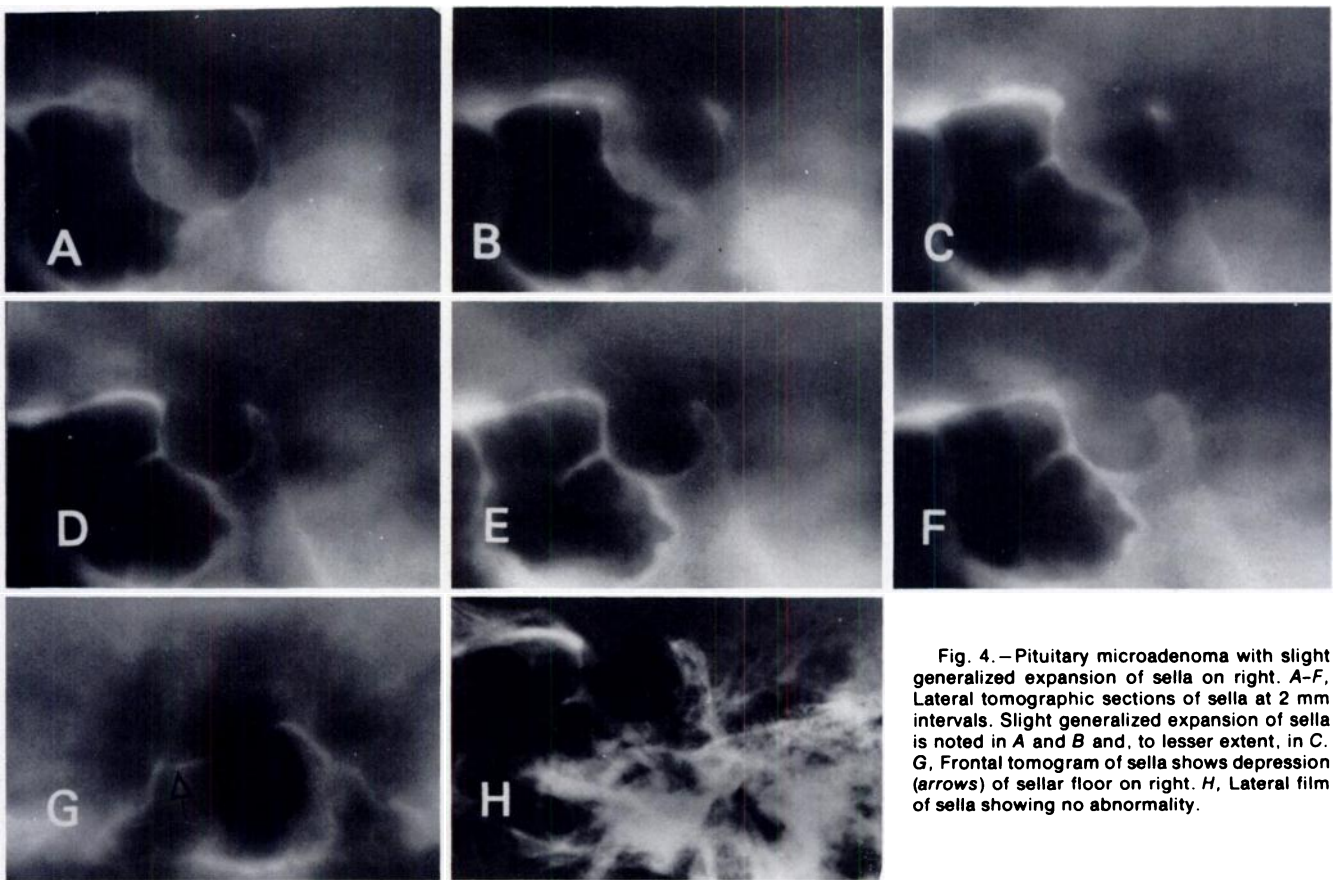


Fig. 4.—Pituitary microadenoma with slight generalized expansion of sella on right. A–F, Lateral tomographic sections of sella at 2 mm intervals. Slight generalized expansion of sella is noted in A and B and, to lesser extent, in C. G, Frontal tomogram of sella shows depression (arrows) of sellar floor on right. H, Lateral film of sella showing no abnormality.

would not have been detected if measurements of only the sellar area and volume were used. However, 72% of the HGH-secreting adenomas and about 70% of the nonsecreting adenomas would have been diagnosed simply by an analysis of sellar area and volume.

The most sensitive radiologic means of detecting pituitary microadenomas was thin-section (hypocycloidal) tomography performed at 2 mm intervals. In our study of the 73 patients considered to have a normal sellar size, all but three of the ACTH-secreting adenomas showed

TABLE 4  
Location of Changes in Sellar Configuration on  
Anteroposterior Tomograms

Microadenoma	Sellar Location			Normal Configu- ration
	Lateral	Central	General	
Secreting:				
ACTH .....	3	2	2	13
Prolactin .....	3	9	3	9
HGH .....	2	5	5	4
Nonsecreting .....	2	2	2	7

Note. — Data on 73 patients with normal sellar area and volume.

an abnormal sellar configuration on the tomograms. Tomography is therefore indicated in all instances of clinically suspected pituitary adenoma in which the sella appears normal on routine frontal and lateral radiographs of the skull.

Hardy [6] suggested a topographic localization for secreting microadenomas within the pituitary gland. He indicated that the HGH-secreting microadenomas were located in the anteroinferior portion of the lateral wing of the gland, the prolactin-secreting microadenomas in the lateral wings of the gland, and the ACTH-secreting adenomas in the midline of the central core of the gland. He suggested that the topographic distribution of secreting microadenomas might therefore correspond to the sites of nuclei or pools of secreting cells in the gland. Vezina and Sutton [3] noted that expansion occurred in the anteroinferior wall on one side of the sella in 14 patients with prolactin-secreting microadenomas who had sellae of normal size. These prolactin-secreting microadenomas tended to depress the floor more inferiorly than HGH-secreting adenomas. They concluded that the type of microadenoma might be predicted on the basis of the location of the sellar abnormality. We, however, found no specific sites for the changes pro-

duced by the different types of adenomas, secreting or nonsecreting, in our 73 patients who had sellae of normal size. Changes in configuration were noted in all parts of the sella for each type of adenoma. The majority of microadenomas, regardless of their specific secreting state, affected the anterior or anteroinferior wall of the sella.

### Conclusions

Radiographic measurements of the sellar area and volume are not reliable indicators of small pituitary adenomas. More sensitive are the changes in sellar configuration assessed by comparing one side of the sella with the other using thin-section (hypocycloidal) tomograms obtained in the frontal and lateral projections. Frontal tomograms frequently showed no abnormality even when lateral tomograms were abnormal. Most pituitary microadenomas, regardless of the secreting type, cause localized bulging in the anterior or anteroinferior wall of the sella. The histologic type of microadenoma cannot be predicted on the basis of the location of the abnormal sellar configuration.

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